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Breastfeeding

An overview of oral and general health benefits

Lindsey Rennick Salone, DDS; William F. Vann Jr., DMD, PhD; Deborah L. Dee, PhD, MPH

During the last several years, investigators have paid considerable attention to the relationship between oral and general health.¹⁻³ Dentists are engaging in new roles as advocates for health promotion and disease prevention beyond the oral cavity. Examples of dentists' willingness to venture outside the realm of traditional oral health issues include the profession's role in embracing counseling regarding cessation of tobacco use,^{4,5} monitoring blood pressure⁶ and participating in the fight against childhood obesity.⁷⁻¹¹ Substantial evidence exists supporting the many health benefits associated with breastfeeding¹²⁻¹⁴; however, the extent of dental professionals' knowledge is uncertain.

The American Academy of Pediatrics¹³ (AAP), Elk Grove Village, Ill., and the World Health Organization,¹⁵ Geneva, state that exclusive breastfeeding, defined as giving an infant only breast milk—no water, no formula and no other liquids or solid foods—is the norm against which all alternative feeding methods should be compared. The 2012 AAP policy statement on breastfeeding and the use of human milk docu-

ABSTRACT

Background. Breastfeeding is the reference against which alternative infant feeding models must be measured with regard to growth, development and other health outcomes. Although not a systematic review, this report provides an update for dental professionals, including an overview of general and oral health-related benefits associated with breastfeeding.

Types of Studies Reviewed. The authors examined the literature regarding general health protections that breastfeeding confers to infants and mothers and explored associations between breastfeeding, occlusion in the primary dentition and early childhood caries. To accomplish these goals, they reviewed systematic reviews when available and supplemented them with comparative studies and with statements and reports from major non-governmental and governmental organizations.

Results. When compared with health outcomes among formula-fed children, the health advantages associated with breastfeeding include a lower risk of acute otitis media, gastroenteritis and diarrhea, severe lower respiratory infections, asthma, sudden infant death syndrome, obesity and other childhood diseases and conditions. Evidence also suggests that breastfed children may develop a more favorable occlusion in the primary dentition. The results of a systematic review in which researchers examined the relationship between breastfeeding and early childhood caries were inconclusive.

Conclusions and Clinical Implications. The American Academy of Pediatric Dentistry, Chicago, suggests that parents gently clean infants' gums and teeth after breastfeeding. The American Academy of Pediatrics, Elk Grove Village, Ill., recommends that breastfeeding should be exclusive for about the first six months of life and should continue, with the introduction of appropriate complementary foods, to at least age 12 months or beyond, as desired by mother and child. Dentists and staff members can take steps to ensure they are familiar with the evidence and guidelines pertaining to breastfeeding and to oral health. They are encouraged to follow the surgeon general's recommendations to promote and support optimal breastfeeding and oral health practices among their patients.

Key Words. Asthma; breastfeeding; primary dentition; occlusion; early childhood caries; gastroenteritis; nonnutritive sucking; obesity; oral habits; otitis media.

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ments the many important reductions in health risks for infants and children, mothers, families and society that are attributable to breastfeeding and the use of human milk for feeding.¹³ These advantages include developmental,¹⁴ economic,^{16,17} health, nutritional, immunological, psychological, social and environmental benefits.¹³ In addition, investigators at an evidence-based research center supported by the Agency for Healthcare Research and Quality, Rockville, Md., conducted a systematic review of the associations between breastfeeding and maternal and child health outcomes, focusing on findings in developed countries.¹² They, too, concluded that substantial reduced health risks can be realized through breastfeeding.¹²

The purpose of this report is to provide an educational update for dentists and dental staff members about the general health advantages and oral health outcomes associated with breastfeeding. In addition, we examine current breastfeeding and oral health recommendations from major pediatric and dental organizations.

METHODS

This is not a systematic review; rather, to provide an update on the maternal and child health benefits associated with breastfeeding, we used results of meta-analyses and systematic reviews when available, and we supplemented these with comparative studies, as well as statements and reports from major nongovernmental and governmental organizations (including “The Surgeon General’s Call to Action to Support Breastfeeding”¹⁸). In examining the relationships between breastfeeding and early childhood caries (ECC), we used the definition provided by the American Academy of Pediatric Dentistry (AAPD), Chicago: “the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of 6 [years].”¹⁹ For our overview of the association between breastfeeding and ECC, as well as for associations between breastfeeding, craniofacial development and dental occlusion, we searched MEDLINE, PubMed and Google Scholar for relevant English-language reviews and comparative studies published from January 1999 through March 2011 by using breastfeeding, craniofacial development, dental occlusion and early childhood caries as key words.

WHY BREASTFEEDING AND BREAST MILK ARE IMPORTANT

The unique properties of breast milk make it the best source of nutrients for infants.¹³ The

policy statement of the AAP Section on Breastfeeding specifies that breast milk is the only source of nutrition a healthy infant requires for about the first six months of life.¹³ Breast milk is tailored to the infant’s specific nutritional needs, contains immunological agents such as secretory immunoglobulin (Ig) A and IgG and has anti-inflammatory properties that offer protection to the potentially immature immune systems of both term and preterm infants.²⁰ Breast milk contains bioactive components that are resistant to digestive processes and that enhance the infant’s immune system, thereby contributing to short- and long-term health protection. Breastfeeding also confers health advantages to mothers.

Reduced health risks for breastfed children. *Protection against short-term infections.*

Acute otitis media. Acute otitis media (AOM), commonly referred to as middle ear infection, is a common infection experienced during childhood. Among U.S. children aged 0 through 4 years, the rate of ambulatory care visits with AOM as the primary diagnosis was 575 per 1,000 visits in 2007.²¹ AOM also is one of the leading causes of hearing loss in children,²² and typically it begins as an upper respiratory-tract infection (RTI) that leads to eustachian tube dysfunction and an ear infection.¹² The bactericidal properties of human milk may help protect against AOM.^{20,23} Investigators conducting a meta-analysis of studies that included children in developed countries found that those who were formula-fed exclusively had twice the risk of developing AOM compared with those who were breastfed exclusively for three or six months.¹²

Gastroenteritis and diarrhea. Gastroenteritis and diarrhea are common among children and can cause dehydration. Globally, researchers have estimated that 1.34 million deaths among children aged 0 through 59 months are attributable to diarrheal disease, making it the second most common cause of mortality among children in this age group.^{24,25} Human milk protects against diarrhea by coating the intestinal lining and killing pathogens that can cause infections.²⁶ In a review of 18 studies, Lamberti and

ABBREVIATION KEY: **AAP:** American Academy of Pediatrics. **AAPD:** American Academy of Pediatric Dentistry. **ADA:** American Dental Association. **AOM:** Acute otitis media. **ECC:** Early childhood caries. **Ig:** Immunoglobulin. **NEC:** Necrotizing enterocolitis. **RTI:** Respiratory-tract infection. **SIDS:** Sudden infant death syndrome. **T2DM:** Type 2 diabetes mellitus.

colleagues²⁵ found that the risk of diarrhea-related mortality among infants 0 through 5 months of age was higher among those who were partially breastfed (relative risk [RR] = 4.62; 95 percent confidence interval [CI], 1.81-11.76) or not breastfed (RR = 10.52; 95 percent CI, 2.79-39.6) than it was among infants who were breastfed exclusively.

Serious infections and diseases. RTIs.

Severe lower RTIs, such as pneumonia and respiratory syncytial virus bronchiolitis, are the most common cause of infectious disease-related hospitalizations among U.S. infants.^{27,28} In addition to accounting for a large proportion of hospitalizations among infants and young children,²⁹ severe lower RTIs increase the risk of developing childhood asthma.³⁰ As with other infections, however, the antibodies and bactericidal properties in breast milk help combat severe lower RTIs.^{20,28,31} The results of a meta-analysis of the risk of being hospitalized for respiratory disease among otherwise generally healthy infants showed a lower risk among those breastfed exclusively for four months than among those who were formula fed (RR = 0.28; 95 percent CI, 0.14-0.54).²⁸

Necrotizing enterocolitis. Necrotizing enterocolitis (NEC) is a severe and often devastating gastrointestinal disease that occurs most often among preterm and low-birth-weight infants, with an estimated prevalence of approximately 5 to 10 percent among very-low-birth-weight (< 1,500 grams) infants³² and high morbidity and case-fatality rates. Abdullah and colleagues³³ estimated that an average NEC-related hospital stay lasts 62 days and costs approximately \$300,000 per infected patient. Many components of breast milk, such as maternal secretory IgA, epidermal growth factor and anti-inflammatory cytokines, decrease the risk of developing NEC by means of their antimicrobial and bactericidal properties.³⁴ Ip and colleagues¹² conducted a meta-analysis of four randomized controlled trials of the relationship between breast milk feeding (that is, directly from the breast, via mothers' expressed breast milk or via donor human milk) and the development of NEC in preterm infants in developed countries; they found an absolute risk difference of 5 percent between infants who were fed breast milk and those who were not. Given the high case-fatality rate associated with NEC, this absolute risk difference is clinically meaningful.

Leukemia. Childhood leukemia is the most common form of childhood cancer in the United States, with an incidence of 49.8 per 1,000,000

among U.S. children aged 0 through 14 years.³⁵ Little is known about its etiology, but research indicates that viruses may play a role. The immune factors in human milk may have a protective effect against leukemia-related viruses. In a meta-analysis of 14 case-control studies of children who were breastfed and those who were not breastfed, researchers concluded that breastfeeding for more than six months significantly reduced the risk of developing acute lymphocytic leukemia (OR = 0.76; 95 percent CI, 0.68-0.84) and acute myelogenous leukemia (OR = 0.85; 95 percent CI, 0.73-0.98).³⁶

Sudden infant death syndrome. Sudden infant death syndrome (SIDS) is the leading cause of death among infants 1 through 12 months of age and the third-highest cause of infant mortality in the United States.^{37,38} Some uncertainty exists regarding how breastfeeding reduces the risk of SIDS; however, the immunological and anti-inflammatory qualities of human milk are mechanisms through which breastfed infants may be protected.^{39,40} For example, infections can lead to inflammatory responses in the respiratory and cardiac systems, but the anti-inflammatory agents in human milk help control infection and prevent illnesses that may be precursors to SIDS.³⁹

Research findings also suggest that breastfed infants are aroused more easily from sleep, which helps protect against SIDS.⁴¹ In a 2007 meta-analysis of six studies in which researchers examined the associations between breastfeeding and SIDS in developed countries, the results showed that breastfed infants had a lower risk of experiencing SIDS than did infants who were never breastfed.¹² The results of a 2011 meta-analysis also showed protective effects of breastfeeding on the risk of experiencing SIDS; compared with the effects for infants who were never breastfed, the strongest effects were observed for infants who were breastfed any amount for at least two months (summary OR = 0.38; 95 percent CI, 0.27-0.54) and for those who were breastfed exclusively for any duration (summary OR = 0.27; 95 percent CI, 0.24-0.31).⁴⁰

Chronic diseases and conditions. Asthma. Asthma is a chronic, inflammatory lung disease with symptoms that include breathing difficulty, wheezing and excessive mucus production; the disease affects 6.3 percent of U.S. children younger than 5 years.⁴² Research findings indicate that IgG immune complexes found in human milk may play a role in protecting breastfed infants against asthma.⁴³ The results of a meta-analysis of 10 prospective studies con-

ducted in developed countries showed that among infants with no family history of asthma, those who were breastfed exclusively for at least three months had a lower estimated risk of developing asthma (summary OR = 0.74; 95 percent CI, 0.60-0.92) compared with infants who were not breastfed.¹²

Obesity. The prevalence of childhood obesity has increased rapidly in the United States during the last few decades; among children and adolescents, the prevalence has virtually tripled since 1980.⁴⁴ Using data from the 2007-2008 National Health and Nutrition Examination Survey, the Centers for Disease Control and Prevention⁴⁴ estimates that approximately 12.5 million people (17 percent) aged 2 through 19 years are obese. Concerns exist regarding the potential long-term negative health effects of obesity, such as the risk of developing heart disease, type 2 diabetes mellitus (T2DM) and cancer, especially among those who continue to be obese into adulthood.⁴⁵ Research results indicate that breastfeeding protects against obesity, possibly by means of improved self-regulation of energy intake and recognition of internal satiety cues in children who are directly breastfed.⁴⁶ Arenz and colleagues⁴⁷ conducted a meta-analysis of nine studies that included more than 69,000 children from developed countries and found that the odds of developing childhood obesity were lower among those who were breastfed than among those who were formula fed (summary OR = 0.78; 95 percent CI, 0.71-0.85). Other investigators have reported similar results, indicating a protective effect of breastfeeding against overweight and obesity.⁴⁸⁻⁵⁰

T2DM. T2DM is diagnosed in approximately 3,600 youth in the United States annually.⁵¹ Breastfeeding may protect against the development of T2DM through behavioral and hormonal mechanisms.^{49,52,53} Research findings suggest that infants who are directly breastfed have better self-regulation of intake compared with bottle-fed infants; this could have effects on intake and resulting weight status later in life, thereby reducing the risk of developing diabetes.⁴⁶ In addition, compared with formula-fed infants, breastfed infants have higher concentrations of polyunsaturated fats in their skeletal muscle membranes, which is associated with lower fasting glucose levels and lower insulin resistance.⁵⁴ The results of a meta-analysis of seven studies consisting of 76,744 people in developed countries showed that participants who were ever breastfed had a lower estimated risk of developing T2DM in later life compared with formula-fed participants (pooled OR = 0.61;

95 percent CI, 0.44-0.85).⁵³

Reduced health risks for mothers who breastfeed. Mothers who breastfeed typically are at a lower risk of developing certain diseases. In general, longer exclusivity and duration of breastfeeding are associated with improved health outcomes. Breastfeeding reduces postpartum bleeding and hemorrhage risk,⁵⁵ which help mothers recover from childbirth. Breastfeeding is associated with longer birth intervals resulting from lactational amenorrhea, or suppression of ovulation, giving mothers' bodies more time to recover fully from pregnancy and childbirth. Breastfeeding also provides women with a nonpharmacological method of family planning.⁵⁵

Breast cancer. Breast cancer is the most commonly diagnosed cancer among women, and it is the second highest cause of cancer mortality in women.⁵⁶ Women who breastfeed may be protected from breast cancer by reduced estrogen exposure through removal via breast fluid, delayed ovulation, an anti-inflammatory response or other mechanisms.^{55,57-60} Several investigators have reported a reduced risk of developing breast cancer among women who breastfeed.^{12,52,57,61,62} In a meta-analysis of 47 studies consisting of more than 145,000 women, researchers concluded that each additional year of breastfeeding reduced a woman's breast cancer risk by 4.3 percent (95 percent CI, 2.9-5.8).⁶¹ Palmer and colleagues⁶² examined risk factors for breast cancer among African American women and found that breastfeeding was associated with a lower risk of developing a particularly aggressive type of breast cancer, especially among women who had a family history of the disease.

Ovarian cancer. Ovarian cancer is the fifth-leading cause of cancer mortality among U.S. women.⁵⁶ Investigators in several studies have reported a reduced risk of ovarian cancer among women who have breastfed.^{12,52,57,58,63} Suppressed ovulation or decreased gonadotropin levels, which occur through oral contraceptive use and breastfeeding,^{64,65} are mechanisms by which the risk of developing ovarian cancer may be reduced. In a study of two prospective cohorts, researchers found that for each month of breastfeeding, the relative risk of developing ovarian cancer decreased by 2 percent (RR = 0.98; 95 percent CI, 0.97-1.00).⁶³ Furthermore, the results of a meta-analysis of the relationship between breastfeeding and ovarian cancer showed that women who had ever breastfed had a lower risk than did those who had never breastfed (summary OR = 0.70; 95 percent CI, 0.59-0.83).¹²

ORAL HEALTH CONSIDERATIONS

Craniofacial growth and development are affected by functional stimuli such as breathing, swallowing, chewing and sucking.⁶⁶ The roles of nutritive sucking, which includes breastfeeding and bottle feeding, and nonnutritive sucking, which includes pacifier and digit sucking, have been of particular interest to researchers. The sucking mechanism used during bottle feeding differs from that used during breastfeeding.⁶⁷⁻⁶⁹ Viggiano and colleagues⁶⁷ described the breastfed child as one who “draws milk, putting both the nipple and areola into the mouth; the movement of lips and tongue contribute more to squeezing than to sucking ... [and] the tongue compresses the soft breast nipple against the palate using a peristaltic-like motion.” The bottle-fed child “uses the tongue with piston-like motion in order to compress the artificial teat against the palate.” These different sucking mechanisms have the potential to predispose a bottle-fed infant to development of a malocclusion.⁶⁷

Challenges exist in designing an investigation of the influence of sucking behaviors on craniofacial growth; however, the results of studies in which researchers used electromyography suggest that the muscle activity of infants who are breastfed exclusively renders them less likely to develop the dysfunctional muscular patterns that might predispose bottle-fed infants to develop a malocclusion.^{68,69}

We identified four clinical studies in which investigators directly examined occlusal characteristics in the primary dentition of children who were bottle-fed versus those who were breastfed as infants.^{67,70-72} Investigators in two of these studies^{70,72} found that breastfeeding was more conducive to the favorable development of occlusion than was bottle feeding. More specifically, Karjalainen and colleagues⁷⁰ examined 148 Finnish children with and without a posterior crossbite. They found that those with no posterior crossbite had had a higher mean duration of breast milk's being their only milk source as an infant than did those who had a posterior crossbite (6.1 months versus 3.6 months, respectively, $P < .01$). In addition, they found a higher mean duration of any breastfeeding among children who did not have a crossbite compared with those who had a crossbite (7.6 months versus 4.7 months, respectively, $P < .002$). Similarly, in a cross-sectional study of 359 6-year-old children in Brazil, Peres and colleagues⁷² found that the prevalence of posterior crossbite was lowest in children who were breastfed for at least nine months compared with those who were breastfed for a shorter duration (8.2 percent versus

15.8-23.1 percent, respectively; $P = .03$).

Viggiano and colleagues⁶⁷ conducted a retrospective study of 1,130 Italian children aged 3 through 5 years. The investigators assessed the odds of developing altered occlusion (open bite or posterior crossbite) in children who were bottle fed (defined as being bottle fed exclusively from birth or fed via bottle starting within the first three months of life) versus those who were breastfed (defined as being breastfed exclusively for more than the first three months of life). They concluded that the way in which a child was fed as an infant was not associated with altered occlusion (OR = 1.28; 95 percent CI, 0.99-1.66). They did find, however, that nonnutritive sucking (that is, sucking an object such as a digit or dummy/pacifier for more than the first year of life) was associated with altered occlusion (adjusted OR = 2.43; 95 percent CI, 1.82-3.25).⁶⁷

Finally, Warren and Bishara⁷¹ conducted a longitudinal study of 372 American children followed up from birth, collecting data regarding sucking habits and feeding practices, as well as other information via periodic questionnaires completed by parents. In addition, the authors obtained study models when the children were 4 to 5 years of age to assess specific malocclusions (that is, anterior overbite, posterior crossbite, overjet ≥ 4 mm and any Class II canine relationship). They found no differences in the prevalence of these malocclusions in the primary dentition of children who were breastfed (defined as any amount of breastfeeding and categorized into durations of less than six months, six to 12 months and more than 12 months) versus those who were bottle fed (defined as no breastfeeding).⁷¹

BREASTFEEDING AND EARLY CHILDHOOD CARIES

In a 2008 systematic review, White⁷³ investigated whether continuation of breastfeeding (compared with other types of infant feeding) increases the risk of developing ECC in infants older than 6 months. She searched three large online databases (MEDLINE, Embase and Cumulative Index to Nursing and Allied Health Literature) and all evidence-based medical journals represented in Ovid for pertinent studies published from 1982 through 2008.⁷³ White identified three comparative studies and two review articles,⁷⁴⁻⁷⁸ one of which she excluded from consideration because it was not written in English.⁷⁶ Definitions of breastfeeding varied across the studies, and they often lacked detail. For example, investigators in two studies exam-

ined the influence of exclusive breastfeeding (breast milk alone or breast milk and water),^{77,78} whereas the authors of the review articles were constrained by the definitions used in the studies they examined, which considered any amount of breastfeeding^{74,75} and allowed for consumption of water, formula or other liquids and foods. In addition, as Valaitis and colleagues⁷⁴ noted, investigators in their systematic review often provided vague definitions of the duration of breastfeeding (for example, “prolonged,” with no unit of measure given) and categorized breastfeeding differently (for example, more than six months, more than one year), making it difficult to compare associations of breastfeeding duration with ECC across those studies.

Valaitis and colleagues⁷⁴ were the only investigators in the four studies^{74,75,77,78} examined by White⁷³ to report evidence suggesting an association between breastfeeding and ECC. Specifically, among researchers in 28 relevant studies identified by Valaitis and colleagues,⁷⁴ those in three⁷⁹⁻⁸¹ studies considered to be of moderate quality on the basis of adapted Cochrane systematic review criteria suggested that breastfeeding for longer than one year and nighttime breastfeeding were associated with caries, nursing caries syndrome or ECC. Among those three studies, however, it was unclear whether investigators adjusted for potential confounders such as fluoride exposure, certain dietary habits and oral hygiene practices, all of which could have affected the results. In light of these issues, Valaitis and colleagues⁷⁴ concluded that the findings of their systematic review did not provide clear evidence of a strong association between breastfeeding and ECC. Researchers in the three comparative studies reviewed by White determined that no evidence existed to confirm an association between breastfeeding and ECC.^{75,77,78} Hence, White⁷³ concluded that, because of the evidence demonstrating important maternal and child health benefits associated with breastfeeding, scientifically rigorous research is needed to elucidate whether associations exist between breastfeeding and ECC, and such evidence is lacking. She recommended that dental professionals encourage parents to begin practicing healthy oral hygiene with their children as soon as the first tooth erupts, and they should keep intake of sugar-sweetened beverages to a minimum.⁷³

DISCUSSION

One of our overarching goals is to provide information about some of the many important health protections that breastfeeding confers to

children and mothers as a means to inform and update the dental profession about the importance of breastfeeding and their role as clinicians in encouraging it. The American Dental Association (ADA), Chicago, has no specific policy statement about breastfeeding; however, in a report regarding fluoride in reconstituted infant formula published in 2011,⁸² the ADA Council on Scientific Affairs included language supportive of the AAP's (then current) 2005 policy on breastfeeding.⁸³ The AAPD does not have a specific policy regarding breastfeeding, but in its recently revised Policy on Dietary Recommendations for Infants, Children and Adolescents, it “encourages breastfeeding of infants to ensure the best possible health and developmental and psychosocial outcomes, with care to wiping or brushing as the first primary tooth begins to erupt and other dietary carbohydrates are introduced.”⁸⁴

Dentists and professional dental associations are concerned about the development of ECC in infants and children. For example, the current AAPD policy statement on ECC recommends that “[a]d libitum breastfeeding should be avoided after the first primary tooth begins to erupt and other dietary carbohydrates are introduced.”¹⁹ The rationale and evidence for the recommendation to avoid ad libitum breastfeeding are unclear. Of the studies and reviews we found, none focused solely on examination of the association between breastfeeding on demand and ECC. Confounding factors, such as carbohydrate consumption and oral hygiene practices, however, have been associated with ECC.^{19,75,84}

Similarly, in their review of the literature pertaining to the relationship between breastfeeding and ECC, Ribeiro and Ribeiro⁷⁵ questioned the basis for recommendations that ad libitum breastfeeding be avoided. They observed that investigators sometimes combined on-demand and nighttime breastfeeding into one category, and that issues related to nighttime breastfeeding may differ from those assumed to be related to on-demand breastfeeding. If clinicians' concerns relate to the possibility that breast milk will pool in the child's mouth during nighttime feedings and remain in contact with the teeth for long periods, Ribeiro and Ribeiro⁷⁵ countered that the biomechanics of breastfeeding differ from those of bottle feeding, with the result being that breast milk is expressed into the soft palate and swallowed. These authors and others pointed to the lack of evidence that human milk is cariogenic and stated that other factors, such as oral hygiene, may be more influential in caries development than is

on-demand breastfeeding.^{73-75,77,78} Thus, on the basis of the current scientific evidence, it appears that the relationship between unrestricted (ad libitum) breastfeeding and an increased risk of developing caries is equivocal.⁷³⁻⁷⁵

We should note that a policy to restrict breastfeeding is inconsistent with the AAP's 2005⁸³ and 2012¹³ breastfeeding recommendations. Furthermore, breast milk production is based largely on infant demand; thus, restricting breastfeeding after the first tooth erupts is detrimental because it threatens to decrease the mother's milk supply and disrupt the child's feeding patterns.^{30,85}

Some professional dental organizations' policies may be confusing to parents when contrasted with the AAP's recommendation¹³ of exclusive breastfeeding for about the first six months of life, the introduction of appropriate complementary foods at about six months of age, and the continuation of breastfeeding for at least the first year of life, and as long thereafter as mutually desired by the mother and child. Other health-focused organizations have published breastfeeding recommendations that are similar to those of the AAP¹³; these include the American Public Health Association,⁸⁶ American College of Obstetricians and Gynecologists,⁸⁷ American Academy of Family Physicians,⁸⁸ American College of Nurse-Midwives⁸⁹ and the American Dietetic Association (now known as the Academy of Nutrition and Dietetics).⁹⁰ All of these organizations recommend that most U.S. infants be breastfed exclusively for about the first six months of life, and that breastfeeding continue for at least the first year of the child's life.

In early 2011, U.S. Surgeon General Regina Benjamin released "The Surgeon General's Call to Action to Support Breastfeeding,"¹⁸ in which she described actions that health care providers, employers and others can take to help mothers who breastfeed. The surgeon general urged that all health professionals who care for mothers and children be educated and trained about the importance of breastfeeding so that they are able to provide their patients with evidence-based information and support. Surgeon General Benjamin also called on all clinicians to ensure that the care they provide is compatible with breastfeeding, and that they do not use practices that unnecessarily interfere with breastfeeding.

CONCLUSIONS

We urge all dental professionals to reflect on the current evidence regarding breastfeeding as dis-

cussed in this article, and we call upon all dental team members to be advocates, promoters and supporters of breastfeeding. We also encourage dental professionals to inform caregivers of the importance of cleansing infants' teeth as soon as they erupt by using a washcloth or soft toothbrush to reduce bacterial colonization and to help reduce children's risk of developing ECC.⁹¹ ■

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1. U.S. Public Health Service, Office of the Surgeon General, National Institute of Dental and Craniofacial Research. Oral Health in America: A Report of the Surgeon General. Rockville, Md.: U.S. Department of Health and Human Services, U.S. Public Health Service; 2000. NIH publication 00-4713.
2. Ostberg AL, Andersson P, Hakeberg M. Oral impacts on daily performances: associations with self-reported general health and medication. *Acta Odontol Scand* 2009;67(6):370-376.
3. Jackson SL, Vann Jr. WF, Pahel BT, Kotch JB, Lee JY. Impact of poor oral health on children's school performance (published online ahead of print Feb. 17, 2011). *Am J Pub Health* 2011;101(10):1900-1906. doi:10.2105/AJPH.2010.200915.
4. Mecklenburg RE. Tobacco prevention and control in dental practice: the future. *J Dent Educ* 2001;65(4):375-384.
5. Samek L. Tobacco cessation: isn't it time for dentistry to become more involved? *J Can Dent Assoc* 2001;67(3):139-140.
6. Glick M. The new blood pressure guidelines: a digest. *JADA* 2004;135(5):585-586.
7. Adair SM. Dietary counseling: time for a nutritionist in the office? *Pediatr Dent* 2004;26(5):389.
8. Glick M. A concern that cannot wait. *JADA* 2005;136(5):572-573.
9. Vann WF, Bouwens TJ, Braithwaite AS, Lee JY. The childhood obesity epidemic: a role for pediatric dentists? *Pediatr Dent* 2005;27(4):271-276.
10. Braithwaite AS, Vann WF Jr, Switzer B, Boyd K, Lee JY. Nutritional counseling practices: how do North Carolina pediatric dentists weigh in? *Pediatr Dent* 2008;30(6):488-495.
11. Hague AL, Touger-Decker R. Weighing in on weight screening in the dental office: practical approaches. *JADA* 2008;139(7):934-938.
12. Ip S, Chung M, Raman G, et al; Tufts-New England Medical Center Evidence-based Practice Center. Breastfeeding and maternal and infant outcomes in developed countries. Rockville, Md.: Agency for Healthcare Research and Quality; 2007. Evidence Report/Technology Assessment 153; AHRQ publication 07-E007.
13. Eidelman AI, Schanler RJ; American Academy of Pediatrics Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics* 2012;129(3):e827-e841.
14. Dee DL, Li R, Lee LC, Grummer-Strawn LM. Associations between breastfeeding practices and young children's language and motor skill development. *Pediatrics* 2007;119(suppl 1):S92-S98.
15. World Health Organization. Fifty-Fourth World Health Assembly. Global strategy for infant and young child feeding: the optimal duration of exclusive breastfeeding. Provisional agenda item 13.1. Geneva: World Health Organization; 2001.
16. United States Breastfeeding Committee. Economic Benefits of Breastfeeding (issue paper). Raleigh, N.C.: United States Breastfeeding Committee; 2002.
17. Bartick M, Reinhold A. The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis (published online ahead of print April 5, 2010). *Pediatrics* 2010;125(5):e1048-e1056. doi:10.1542/peds.2009-1616.
18. U.S. Department of Health and Human Services, U.S. Public Health Service, Office of the Surgeon General; U.S. Public Health Service, Office on Women's Health. The Surgeon General's Call to Action to Support Breastfeeding. Washington: U.S. Department of

Health and Human Services, U.S. Public Health Service, Office of the Surgeon General; 2011.

19. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies (revised 2011). *Ped Dent* 2012;34(6):50-52. www.aapd.org/media/Policies_Guidelines/P_ECCclassifications.pdf. Accessed Jan. 2, 2013.

20. Garofalo RP, Goldman AS. Expression of functional immunomodulatory and anti-inflammatory factors in human milk. *Clin Perinatol* 1999;26(2):361-377.

21. Health Indicators Warehouse. Otitis media visits in ambulatory care settings (per 1,000). www.healthindicators.gov/Indicators/Otitismediavisitsinambulatorycaresettings_743/Profile/Data. Accessed Dec. 3, 2012.

22. Gravel JS, Wallace IF. Effects of otitis media with effusion on hearing in the first three years of life. *J Speech Lang Hear Res* 2000;43(3):631-644.

23. Sabirov A, Casey JR, Murphy TF, Pichichero ME. Breastfeeding is associated with a reduced frequency of acute otitis media and high serum antibody levels against NTHi and outer membrane protein vaccine antigen candidate P6. *Pediatr Res* 2009;66(5):565-570.

24. Black RE, Cousens S, Johnson HL, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality in 2008: a systematic analysis (published online ahead of print May 11, 2010). *Lancet* 2010;375(9730):1969-1987. doi:10.1016/S0140-6736(10)60549-1.

25. Lamberti LM, Fischer Walker CL, Noiman A, Victora C, Black RE. Breastfeeding and the risk for diarrhea morbidity and mortality. *BMC Public Health* 2011;11(suppl 3):S15.

26. Newburg DS, Ruiz-Palacios GM, Morrow AL. Human milk glycans protect infants against enteric pathogens. *Annu Rev Nutr* 2005;25:37-58.

27. Yorita KL, Holman RC, Sejvar JJ, Steiner CA, Schonberger LB. Infectious disease hospitalizations among infants in the United States. *Pediatrics* 2008;121(2):244-252.

28. Bachrach VR, Schwarz E, Bachrach LR. Breastfeeding and the risk of hospitalization for respiratory disease in infancy: a meta-analysis. *Arch Pediatr Adolesc Med* 2003;157(3):237-243.

29. U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. *Child Health USA 2011*. Rockville, Md.: U.S. Department of Health and Human Services; 2011. <http://mchb.hrsa.gov/chusa11/>. Accessed Dec. 17, 2012.

30. Shay DK, Holman RC, Newman RD, Lui LL, Stout JW, Anderson LJ. Bronchiolitis-associated hospitalizations among US children, 1980-1996. *JAMA* 1999;282(10):1440-1446.

31. Lawrence RA, Lawrence RM. *Breastfeeding: A Guide for the Medical Profession*. 7th ed. Maryland Heights, Mo.: Mosby Elsevier; 2011.

32. Thompson AM, Bizzarro MJ. Necrotizing enterocolitis in newborns: pathogenesis, prevention, and management. *Drugs* 2008;68(9):1227-1238.

33. Abdullah F, Zhang Y, Camp M, et al. Necrotizing enterocolitis in 20,822 infants: analysis of medical and surgical treatments. *Clin Pediatr (Phila)* 2010;49(2):166-171.

34. Thibeau SM, D'Apolito K. Review of the relationships between maternal characteristics and preterm breastmilk immune components (published online ahead of print March 28, 2011). *Biol Res Nurs* 2012;14(2):207-216. doi:10.1177/1099800411400064.

35. U.S. Cancer Statistics Working Group. Age-adjusted invasive cancer incidence rates and 95% confidence intervals for ages 0-19 by International Classification of Childhood Cancer (ICCC) group and subgroup, and age, United States, 2004-2008. Table 1.2.2.1: Leukemias, myeloproliferative & myelodysplastic diseases. <http://apps.nccd.cdc.gov/uscs/childhoodcancerdetailedbyICCC.aspx>. Accessed Jan. 2, 2013.

36. Kwan ML, Buffler PA, Abrams B, Kiley VA. Breastfeeding and the risk of childhood leukemia: a meta-analysis. *Public Health Rep* 2004;119(6):521-535.

37. Shapiro-Mendoza CK, Tomashek KM, Anderson RN, Wingo J. Recent national trends in sudden, unexpected infant deaths: more evidence supporting a change in classification or reporting. *Am J Epidemiol* 2006;163(8):762-769.

38. Xu JQ, Kochanek KD, Murphy SL, Tejada-Vera B. Deaths: final data for 2007. *National Vital Statistics Reports*. Volume 58, Number 19. Hyattsville, Md.: National Center for Health Statistics; 2010. www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf. Accessed

Jan. 2, 2013.

39. Vennemann MM, Bajanowski T, Brinkmann B, et al; GeSID Study Group. Does breastfeeding reduce the risk of sudden infant death syndrome? *Pediatrics* 2009;123(3):e406-e410.

40. Hauck FR, Thompson JMD, Tanabe KO, Moon RY, Vennemann MM. Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis (published online ahead of print June 13, 2011). *Pediatrics* 2011;128(1):103-110. doi:10.1542/peds.2010-3000.

41. Horne RS, Parslow PM, Ferens D, Watts AM, Adamson TM. Comparison of evoked arousability in breast and formula fed infants. *Arch Dis Child* 2004;89(1):22-25.

42. Centers for Disease Control and Prevention. 2009 National Health Interview Survey (NHIS) Data. Table 4-1: Current asthma prevalence percents by age, United States: National Health Interview Survey, 2009. www.cdc.gov/asthma/nhis/09/table4-1.htm. Accessed Dec. 3, 2012.

43. Mosconi E, Rekima A, Seitz-Polski B, et al. Breast milk immune complexes are potent inducers of oral tolerance in neonates and prevent asthma development (published online ahead of print May 19, 2010). *Mucosal Immunol* 2010;3(5):461-474. doi:10.1038/mi.2010.23.

44. Centers for Disease Control and Prevention. Overweight and obesity. Data and statistics. Obesity rates among all children in the United States. www.cdc.gov/obesity/childhood/data.html. Accessed Dec. 3, 2012.

45. Centers for Disease Control and Prevention. Overweight and obesity. Causes and consequences. What causes overweight and obesity? www.cdc.gov/obesity/causes/health.html. Accessed Dec. 18, 2012.

46. Li R, Fein SB, Grummer-Strawn LM. Do infants fed from bottles lack self-regulation of milk intake compared with directly breastfed infants? (published online ahead of print May 10, 2010). *Pediatrics* 2010;125(6):e1386-e1393. doi:10.1542/peds.2009-2549.

47. Arenz S, Ruckerl R, Koletzko B, von Kries R. Breast-feeding and childhood obesity: a systematic review. *Int J Obes Relat Metab Disord* 2004;28(10):1247-1256.

48. Weng SF, Redsell SA, Swift JA, Yang M, Glazebrook CP. Systematic review and meta-analysis of risk factors for childhood overweight identifiable in infancy (published online ahead of print Oct. 29, 2012). *Arch Dis Child* 2012;97(12):1019-1026. doi:10.1136/archdischild-2012-302263.

49. Mayer-Davis EJ, Rifas-Shiman SL, Zhou L, Hu FB, Colditz GA, Gillman MW. Breast-feeding and risk for childhood obesity: does maternal diabetes or obesity status matter? *Diabetes Care* 2006;29(10):2231-2237.

50. Hummel S, Pfluger M, Kreichauf S, Hummel M, Ziegler A-G. Predictors of overweight during childhood in offspring of parents with type 1 diabetes (published online ahead of print Feb. 19, 2009). *Diabetes Care* 2009;32(5):921-925. doi:10.2337/dc08-1943.

51. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States. 2011. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011. www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf. Accessed Jan. 2, 2013.

52. Gouveri E, Papanas N, Hatzitolios AI, Maltezos E. Breastfeeding and diabetes. *Curr Diabetes Rev* 2011;7(2):135-142.

53. Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Does breastfeeding influence risk of type 2 diabetes in later life? A quantitative analysis of published evidence (published correction appears in *Am J Clin Nutr* 2012;95(3):779). *Am J Clin Nutr* 2006;84(5):1043-1054.

54. Das UN. Breastfeeding prevents type 2 diabetes mellitus: but, how and why? *Am J Clin Nutr* 2007;85(5):1436-1437.

55. Heinig MJ. Health effects of breast feeding for mothers: a critical review. *Nutr Res Rev* 1997;10(1):35-56.

56. U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999-2008. Incidence and mortality Web-based report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2012. <http://apps.nccd.cdc.gov/uscs/toptencancers.aspx>. Accessed Jan. 3, 2013.

57. Stuebe A. The risks of not breastfeeding for mothers and infants. *Rev Obstet Gynecol* 2009;2(4):222-231.

58. Schindler AE. Benefits and risks of ovarian function and reproduction for cancer development and prevention (published online ahead of print April 18, 2011). *Gynecol Endocrinol* 2011;27(12):1043-1047. doi:10.3109/09513590.2011.569788.

59. Millikan RC, Newman B, Tse CK, et al. Epidemiology of basal-like breast cancer (published online ahead of print June 20, 2007). *Breast Cancer Res Treat* 2008;109(1):123-139. doi:10.1007/s10549-007-9790-6.
60. Symmans W, Fitterman D, Anderson S, et al. A single-gene biomarker identifies breast cancers associated with immature cell type and short duration of prior breastfeeding. *Endor Relat Cancer* 2005;12(4):1059-1069.
61. Collaborative Group on Hormonal Factors in Breast Cancer. Breast cancer and breastfeeding: collaborative reanalysis of individual data from 47 epidemiological studies in 30 countries, including 50302 women with breast cancer and 96973 women without the disease. *Lancet* 2002;360(9328):187-195.
62. Palmer JR, Boggs DA, Wise LA, Ambrosone CB, Adams-Campbell LL, Rosenberg L. Parity and lactation in relation to estrogen receptor negative breast cancer in African American women (published online ahead of print Aug. 16, 2011). *Cancer Epidemiol Biomarkers Prev* 2011;20(9):1883-1891. doi:10.1158/1055-9965.EPI-11-0465.
63. Danforth KN, Tworoger SS, Hecht JL, Rosner BA, Colditz GA, Hankinson SE. Breastfeeding and risk of ovarian cancer in two prospective cohorts (published online ahead of print April 21, 2007). *Cancer Causes Control* 2007;18(5):517-523. doi:10.1007/s10552-007-0130-2.
64. Risch HA. Hormonal etiology of epithelial ovarian cancer, with a hypothesis concerning the role of androgens and progesterone. *J Natl Cancer Inst* 1998;90(23):1774-1786.
65. McNeilly AS. Lactational control of reproduction. *Reprod Fertil Dev* 2001;13(7-8):583-590.
66. Proffit WR. The etiology of orthodontic problems. In: Proffit WR, Fields HW Jr, Sarver DM, eds. *Contemporary Orthodontics*. 4th ed. St. Louis: Mosby Elsevier; 2007:130-161.
67. Viggiano D, Fasano D, Moncaco G, Strohenger L. Breast feeding, bottle feeding, and non-nutritive sucking; effects on occlusion in deciduous dentition. *Arch Dis Child* 2004;89(12):1121-1123.
68. Inoue N, Sakashita R, and Kamegai T. Reduction of masseter muscle activity in bottle-fed babies. *Early Hum Dev* 1995;42(3):185-193.
69. Gomes CF, Trezza EM, Murade EC, Padovani CR. Surface electromyography of facial muscles during natural and artificial feeding of infants. *J Pediatr (Rio J)* 2006;82(2):103-109.
70. Karjalainen S, Rönning O, Lapinleimu, Simell O. Association between early weaning, non-nutritive sucking habits and occlusal anomalies in 3-year-old Finnish children. *Int J Paediatr Dent* 1999;9(3):169-173.
71. Warren JJ, Bishara SE. Duration of nutritive and nonnutritive sucking behaviors and their effects on the dental arches in the primary dentition. *Am J Orthod Dentofacial Orthop* 2002;121(4):347-356.
72. Peres KJ, Barros AJ, Peres MA, Victora CG. Effects of breastfeeding and sucking habits on malocclusion in a birth cohort study. *Rev Saude Publica* 2007;41(3):343-350.
73. White V. Breastfeeding and the risk of early childhood caries. *Evid Based Dent* 2008;9(3):86-88.
74. Valaitis R, Hesch R, Passarelli C, Sheehan D, Sinton J. A systematic review of the relationship between breastfeeding and early childhood caries. *Can J Public Health* 2000;91(6):411-417.
75. Ribeiro NM, Ribeiro MS. Breastfeeding and early childhood caries: a critical review (in Portuguese). *J Pediatr (Rio J)* 2004;80(suppl 5):S199-S210.
76. Vitolo MR, Bortolini GA, Feldens CA. Impacts of the 10 steps to healthy feeding in infants: a randomized field trial (in Portuguese) (published online ahead of print Sept. 12, 2005). *Cad Saude Publica* 2005;21(5):1448-1457. doi:10.1590/S0102-311X2005000500018.
77. Iida H, Auinger P, Billings RJ, Weitzman M. Association between infant breastfeeding and early childhood caries in the United States. *Pediatrics* 2007;120(4):e944-e952.
78. Kramer MS, Vanilovich I, Matush L, et al. The effect of prolonged and exclusive breast-feeding on dental caries in early school-age children: new evidence from a large randomized trial (published online ahead of print Sept. 18, 2007). *Caries Res* 2007;41(6):484-488. doi:10.1159/000108596.
79. al-Deshti AA, Williams SA, Curzon MEJ. Breast feeding, bottle-feeding and dental caries in Kuwait, a country with low-fluoride levels in the water supply. *Community Dent Health* 1995;12(1):42-47.
80. Derkson GD, Ponti P. Nursing bottle syndrome; prevalence and etiology in a non-fluoridated city. *J Can Dent Assoc* 1982;48(6):389-393.
81. Williams SA, Hargreaves JA. An inquiry into the effects of health related behaviour on dental health among young Asian children resident in a fluoridated city in Canada. *Community Dent Health* 1990;7(4):413-420.
82. Berg J, Gerweck C, Hujoel PP, et al; American Dental Association Council on Scientific Affairs Expert Panel on Fluoride Intake From Infant Formula and Fluorosis. Evidence-based clinical recommendations regarding fluoride intake from reconstituted infant formula and enamel fluorosis: a report of the American Dental Association Council on Scientific Affairs. *JADA* 2011;142(1):79-87.
83. Gartner LM, Morton J, Lawrence RA, et al; American Academy of Pediatrics Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics* 2005;115(2):496-506.
84. American Academy of Pediatric Dentistry. Policy on dietary recommendations for infants, children, and adolescents (revised 2011). *Pediatr Dent* 2012;34:56-58. www.aapd.org/media/Policies_Guidelines/P_DietaryRec.pdf. Accessed Jan. 2, 2013.
85. Lauwers J, Shinskie D, Breck S. *Counseling the Nursing Mother: A Lactation Consultant's Reference*. 3rd ed. Sudbury, Mass.: Jones and Bartlett; 2000.
86. American Public Health Association. Policy Statement Database. A call to action on breastfeeding: a fundamental public health issue. 2007. Policy No. 200714. www.apha.org/advocacy/policy/policysearch/default.htm?id=1360. Accessed Dec. 3, 2012.
87. Committee on Health Care for Underserved Women, American College of Obstetricians and Gynecologists. ACOG committee opinion no. 361: breastfeeding—maternal and infant aspects. *Obstet Gynecol* 2007;109(2 part 1):479-480.
88. American Academy of Family Physicians. Breastfeeding, family physicians supporting (position paper). 2008. www.aafp.org/online/en/home/policy/policies/b/breastfeedingpositionpaper.html. Accessed Dec. 3, 2012.
89. American College of Nurse-Midwives, Division of Women's Health Policy and Leadership, Breastfeeding Task Force. Position statement: breastfeeding. Revised May 2011. www.midwife.org/ACNM/files/ACNMLibraryData/UPLOADFILENAME/000000000248/Breastfeeding%20statement%20May%202011.pdf. Accessed Jan. 2, 2013.
90. James DC, Lesson R; American Dietetic Association. Position of the American Dietetic Association: promoting and supporting breastfeeding. *J Am Diet Assoc* 2009;109(11):1926-1942.
91. American Academy of Pediatric Dentistry. Guideline on infant oral health care. American Academy of Pediatric Dentistry reference manual 2010-2011. *Pediatr Dent* 2010-2011;32(6 reference manual):114-118. www.aapd.org/media/Policies_Guidelines/G_infantOralHealthCare.pdf. Accessed Jan. 2, 2013.